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DOES LOWER TRANSACTION PRICE ATTRACT MORE CUSTOMERS? :

AN EMPIRICAL STUDY ON THE SHORT- & LONG-TERM IMPACTS OF ONLINE BROKERAGE SERVICES

Des prix de transaction plus bas attirent-ils plus de consommateurs? Une étude empirique des effets à long et court terme sur les services de courtage en ligne

Completed Research Paper

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Abstract

We examine price and quality as variables to examine the determinants of online brokerage's market share and empirically investigate the effects using panel data during an eight-year span. Panel data not only allows us to isolate the short-term from that of the long-term impacts of online services on firm performance, but also to avoid the problem of studying "disequilibrium" in a "land rush" period of e-commerce. Our study identifies the significant role of interest revenue in the brokerage business and the central contribution of service quality in increasing interest revenue. We show that the businesses' adequate management of the two generic strategies – price leadership and quality differentiation – can maximize aggregate revenues from various sources. Our study helps various businesses understand the underlying businesses principles by unraveling the effects of the interaction between price and quality strategies and their contribution to the respective and aggregate revenues.

Keywords: Online Brokerage Service, Price and quality competition

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Utilisant des données trimestrielles sur une période de huit ans, nous étudions vingt sociétés de courtage en ligne pour examiner les effets du prix et de la qualité des services sur les résultats de l'entreprise. A long terme, la qualité joue un rôle principal sur la part du marché des sociétés, alors que des réductions de prix n'ont qu'un effet sur le court terme.

Introduction

Price and quality have been central issues worthy of investigation for business success (Dumrongsiri et al. 2008). It is not unique to the online service area. Stimulation of more transactions via the prices and services online customers prefer is a generic strategy for online businesses. Seeking more transactions through changes in prices and services is a strategy that goes beyond online brokerage and can be applied to online businesses in general. Low search and information costs make customers more knowledgeable hence help perfect the marketplace by pushing online markets toward a greater degree of price and quality competitions (Bakos 2001, Koch and Cebula 2002).

The same phenomenon is observed in the online brokerage area. Among the many ecommerce applications, online brokerage is truly one of the best areas to fully explore and implement the benefits of ecommerce (Koch and Cebula, 2002) as a “killer application” in the B2C ecommerce world (Chin and Hitt 2002). However, the appropriateness of the online medium for brokerage services not only delivers business opportunities for online brokerages but also endangers their returns by causing a near perfect competitive market environment due to the extreme homogeneity of goods to be traded. The quality of online brokerage systems has unequivocally trended upward with significant IT investments. However, the brokerage commission has fallen again in recent years. This may show how fiercely online brokerages have been competing to retain customers by investing in the quality of the trading systems and reducing commission fees (Balasubramanian, et al. 2003, Strader and Ramaswami 2004, Looney et al. 2006).

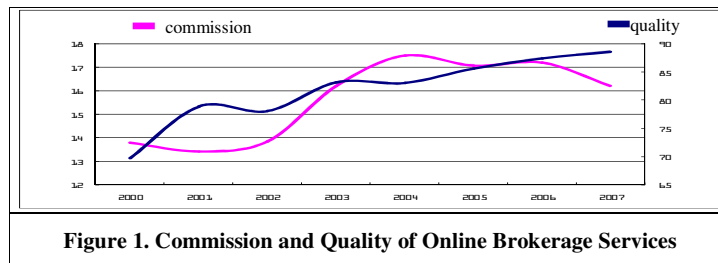


Figure 1. Commission and Quality of Online Brokerage Services

However, the real contribution of these two strategies – low price and high quality – to the improvement of business performance remains an open question due to the limitation of empirical measurement. First, accessing price data from various data points over long periods of time is a tedious task requiring lots of time and effort, especially for online businesses where dynamic change of price is prevalent (Koch and Cebula, 2002). Second, because of the implicit characteristics in the IT system, the quality measurement for online brokerage system requires a careful development of a conceptual framework (Krishnan et al. 1999). Furthermore, most of the existing examinations of price and quality are not linked to the outcome of business performance, focusing on the price discrimination and quality differentiation issues on the web (Smith and Brynjoffson 2001, Bakos 2001, Brown and Goolsbee 2002). Even if the factors are linked to the financial performance, which is mostly based on the managers' *perception* (Wu et al. 2003, Saini and Johnson 2005), they still bear a probable discrepancy from the real performance of online brokerage.

Based on this, there is a paucity of empirical investigation in the online service area, on the contribution of price and quality to business performance. In existing research, both price and quality have been the subject of separate studies, thus failing to deliver an integrative investigation on these two factors. Chen and Hitt (2002) identify the role of online brokerage service in generating switching cost, however, the price impact is not considered. Smith and Brynjoffson (2001) identify that few ecommerce firms, which had adopted a low price strategy, have survived implying a price premium based on brand. However their investigation does not cover quality impact. An explicit relation between these two strategies and the online brokerages' performance has not been empirically studied in an integrative manner (Weinhardt et al. 2000).

Our panel data, collected for an eight years span from year 2000 to 2007 includes quality and price data as well as financial performance data of twenty online brokerages, which provides a unique data set in studying the business performance of online brokerages. Our dataset gives us the rare opportunity to examine how the interactions of these

two factors contribute to establishing market shares of online brokerages. The relatively long dataset period enables us to isolate long-term and short-term effects.

Therefore, the objective of this paper is to empirically investigate the effects of these two strategic choices - price discount and quality investment - on the performance of online brokerages in a comprehensive manner. First, by investigating the independent impact of each factor, we identify the relative significance of two factors. We investigate it in not only a short-term but also a long-term perspective. Thereby, we answer the following two questions: (1) Which factor contributes the most to the current market share of online brokerages, price discount or quality improvement? (2) In the long-term, which factor contributes the most to the performance, price discount or quality improvement? More importantly, we employ an integrative investigation on the impact and relationship of price and quality, which emphasizes the unique value of our study. For this purpose, we find the answers to the questions: (3) Under which conditions, does the low price strategy contribute to the performance of online brokerage? (4) How are the price and quality of online brokerages correlated? First, we analyze it with aggregate revenue data of brokerage services. Then, we separate the brokerage revenue into implicit revenue (e.g. interest revenue from deposits) and brokerage commission, thus examining which factor is influential in incentivizing customers in different revenue sources. By investigating a revenue source which makes a more significant contribution to the total revenue and the factors influencing this revenue source, businesses can understand how to leverage it in order to increase total revenue based on price and quality strategies.

Basically, our study has significant value in that we give explicit answers to the likely but untested strategic options for online brokerages – are the price discount and quality investment strategies really effective in its growth? Moreover, our investigation can enhance the understanding of online business strategies beyond the online brokerage business. While lower search cost provide consumers with a wider range of choices, it also intensifies the degree of competition between online businesses. Even though the low price and high quality strategy carries the advantages of extending the consumer base, for the online businesses, it means reduced marginal profit and increased marginal cost. Hence, the strategic alignment of these two options is a fundamental and serious business decision for online businesses.

In the following section, we characterize the price and quality factors in the context of online brokerage, thereby we examine their contribution to attracting customers. Additionally, we present a theoretical basis connecting individual choice to firm-level performance in terms of market share. In section 3, we posit our hypothesis, and in the ensuing section, we describe our data and empirical models with further discussion on the advantages of our data set. We discuss results and conclusion in sections 5 and 6, respectively.

Theoretical Background

Characterization of Price and Quality in Online Brokerage Service

The online brokerages have transformed the trading from professional to commoditized activities. With the increasing importance of private investors, the necessity to satisfy their needs with regard to the usage of trading systems has been increasing greatly (Weinhardt et al. 2000). Like any other economic choice, when traders choose online brokerage, they consider their total transaction costs and choose the online brokerage which minimizes costs (Williamson 1981). Konana et al. (2000)'s framework on the selection process of online brokerage gives us a straightforward understanding of the role of price and quality in terms of transaction cost and customer attraction: price plays a key role on the direct costs of a transaction, while quality of brokerage services influences indirect costs of transactions. Since online trading systems replace consumers' face-to-face interactions, the service quality of the brokerages can be mostly captured by the quality of the systems. Therefore, in the online brokerage setting, while direct costs include commissions and taxes for online trading, indirect costs, which involve the effort or time required for online trading and any other opportunity costs (e.g. transaction delay), are significantly determined by the quality of the online trading system.

The commission of online brokerages is explicitly observed but there is high uncertainty about the quality measure of online trading systems. If consumers' ability to distinguish these unobserved costs associated with quality is inadequate, they will consider the low commission as their overall transaction cost (Konana et al. 2000). Online brokerages will provide these customers with a significant value proposition via deep-discount of commissions (Rajgopal et al 2001). The start-up brokerages also have adopted this tactic to attract price-sensitive customers from

a well-known incumbent (Lim 2003). Hence, in the online brokerage business, price leadership has been conceived as an efficient tactic for customer acquisition.

However, the retention of customers, in other words the persistence of customer acquisition, depends on overall observation of price as well as quality. Unless the advantage of low commission compensates customers' dissatisfaction with the system's quality, customers would consider switching to other brokerages. However, again, while the search cost of price is very low in an online environment, the cost of quality investigation for untested system is not negligible, which increases switching cost (Zeithamal et al. 2000): a customer can suffer a significant financial loss by moving to a brokerage offering an inferior trading system. Hence, quality has double-edged impacts on a customer's decision: if it does not meet a customer's expectation, it cannot retain the customer but, if it does, the customer cannot easily switch due to the opportunity costs involved in systems that are highly mission critical. Satisfaction with the current brokerage can significantly deter customers from switching.

Of course, since it is an online service, not only price but also quality of online brokerage may be easily imitated by competitors (Rajgopal et al 2001). However, we expect the difference in search and opportunity cost involved in these two factors to deliver different sustainability in contributing to the performance. Price may have a much stronger effect on short-term market share, while quality exhibits a more lasting impact. Furthermore, given this rationale, we expect persisting impact of price only when combined with the system of high quality, which is our integrative perspective on the performance contribution of two key factors.

Individual Choice Model and Market Share Model

Our objective is to identify the impact of price and quality on the firm's market share. Market share means the aggregate choices of customers of a particular firm. Hence, in order to explain why some factors positively or negatively affect market share, we need to understand how those factors affect customer decisions. The best way to examine customer's decisions would be to investigate customer-level online trading data. However, necessary and validated micro-data on individual transactions with cross-sectional characteristics over extended time periods are rarely available (Kim et al. 2001). By directly observing market share – the collective measure of individual choice, we can identify how price and quality contributes to market share by affecting customers' decision. In this section, we describe how the determinants of consumer choices can be integrated with the determinants of market share by showing the conceptual consistency between an individual choice model and a market share model.

First, McFadden's (1975) random utility model predicts the choice probability of a product/service through the utility-relevant attributes. Hence it has been extensively adopted (Guadagni and Little 1983, Brynjolfsson and Smith 2001, Chen and Hitt 2002) to explain consumer choices among multiple discrete alternatives. A customer's choice of brokerage i's service at time t reveals her chosen preference for the service of that brokerage. In a random utility model, a consumer's utility from choosing firm i's product/service at time t is defined such that:

$$u_{it} = v_{it} + \varepsilon_{it} = \alpha_i - \gamma p_{it} + \sum_{k=1}^K \beta_k X_{itk} + \varepsilon_{it} \quad (1)$$

Here, α_i is the parameter for the intrinsic value of firm i's product/service and p_{it} denotes the price of firm i's product/service. X_{itk} is the value of the k-th non-price attribute of the firm i's product/service, and this K-dimensional attribute vector are utility-relevant attributes from physical characteristic of products to the qualities of service/product (Manski 1977). The parameters γ and β_k represent the weights reflecting the importance of price and other attributes, respectively, and ε_{it} is the error term. The customer's utility is influenced by the combination of price and non price-attributes (e.g. quality factors), and the probability that a consumer will choose firm i's product/quality among J firms is determined by the relative utility level:

$$\Pr_{it} = \frac{\exp(v_{it})}{\sum_{j=1}^J \exp(v_{jt})} \quad (2)$$

If we aggregate equation (2) over the customers and derive the mean probability, it leads to the collective average probability of choosing firm i's product/service, which is a market share of firm i's product/service – the proportion of customers who have that choice.

Next, Cooper (1993) defines the market share of firm i (for a certain product/service) at time t.

$$S_{it} = \frac{A_{it}}{\sum_{j=1}^J A_{jt}} \quad (3)$$

Because we are analyzing the online brokerage service, the market share is limited to brokerage service for online trading. The market share for other service (e.g. financial product sales) is not considered in this study. In the market share model, A_{it} implies “attractiveness of a firm’s product/service” and is also interpreted as “marketing effort for a product/service by firm i” in Kotler (1984)’s terminology. There are a wide range of choices in the specification of the functional form for A_{it} , from a multiplicative model to a linear one. If we adopt the exponential form for the “attractiveness” function:

$$A_{it} = \exp(\alpha_i - \gamma p_{it} + \sum_{k=1}^K \beta_k X_{ikt} + \varepsilon_{it}) \quad (4)$$

and substitute equation (4) into equation (3), we derive the following:

$$\frac{\exp(\alpha_i - \gamma p_{it} + \sum_{k=1}^K \beta_k X_{ikt} + \varepsilon_{it})}{\sum_{j=1}^J \exp(\alpha_j - \gamma p_{jt} + \sum_{k=1}^K \beta_k X_{jkt} + \varepsilon_{jt})} \quad (5)$$

Therefore, Cooper’s market-share model (1993) has the same underlying concept as the individual choice model in that it is determined by the relative attractiveness factors (e.g. price and non-price attributes) of the firm’s product/service. Through the attributes of a firm’s price/quality, the former investigates collective average probability of choice while the latter examines individual choice probability.

The log-centering transformation of the MNL (Multi Nominal Logit) market-share model enables us to estimate the parameters of the original non-linear model via linear regression techniques. First, by taking the logarithm of equation (5), we get:

$$\log s_{it} = \alpha_i - \gamma p_{it} + \sum_{k=1}^K \beta_k X_{ikt} + \varepsilon_{it} - \log \sum_{j=1}^J (\exp(\alpha_j - \gamma p_{jt} + \sum_{k=1}^K \beta_k X_{jkt} + \varepsilon_{jt})) \quad (6)$$

If we sum equation (6) over i and divide by J, we get

$$\log \tilde{s}_t = \bar{\alpha} - \gamma \bar{p}_t + \sum_{k=1}^K \beta_k \bar{X}_{kt} + \bar{\varepsilon}_t - \log \sum_{j=1}^J (\exp(\alpha_j - \gamma p_{jt} + \sum_{k=1}^K \beta_k X_{jkt} + \varepsilon_{jt})) \quad (7)$$

where \tilde{s}_t is the geometric mean of s_{it} , and $\bar{\alpha}$, \bar{p}_t , \bar{X}_{kt} and $\bar{\varepsilon}_t$ are the arithmetic means of α_i , p_{it} , X_{ikt} and ε_{it} respectively. Subtracting equation (7) from equation (6), we have:

$$\log\left(\frac{s_{it}}{\tilde{s}_t}\right) = (\alpha_i - \bar{\alpha}) + \gamma(p_{it} - \bar{p}_t) + \sum_{k=1}^K \beta_k (X_{ikt} - \bar{X}_{kt}) + (\varepsilon_{it} - \bar{\varepsilon}_t) \quad (8)$$

Deleted:

Setting $s_{it}^* = \frac{s_{it}}{\tilde{s}_t}$, $\alpha_i^* = (\alpha_i - \bar{\alpha})$, $p_{it}^* = (p_{it} - \bar{p}_t)$ and $X_{ikt}^* = (X_{ikt} - \bar{X}_{kt})$, we get the following reduced form:

$$\log(s_{it}^*) = \alpha_i^* - \gamma p_{it}^* + \sum_{k=1}^K (\beta_k X_{ikt}^*) + \varepsilon_{it} - \bar{\varepsilon}_t \quad (9)$$

In equation (9), α_i^* denotes the brokerage-specific fixed effects, while $\bar{\varepsilon}_t$ captures the variation of each brokerage’s time-varying variables, which is common to all firms. Hence, equation (9) leads to the typical panel data regression model considering both the brokerage-specific fixed effects and period-fixed effects (Judge et al. 1982). The former effects capture the idiosyncratic and time-constant unobserved characteristics of each brokerage, thus controlling intrinsic brokerage characteristics, which inherently affect market share. Additionally, the time-fixed effects represent any influence on market share by timing differences in each brokerage (Wooldridge 2002).

Hypothesis

Price and quality have been recognized as key factors for customer satisfaction and value proposition (Jiang and Rosenbloom 2005). Customer satisfaction with price or quality of online services is connected to favorable word-of-

mouth and the intention to transact in that online business (Kim et al. 2002, Zhang and Prybutok 2005). Therefore, prior studies on consumer satisfaction with a product/service give us the rationale that favorable price and quality contribute to customer attraction (Pikkariainen et al. 2004, Jiang and Rosenbloom 2005, Floh and Treiblmaier 2006), which leads to the increased market share of the business.

First, because price is a direct transaction cost which reduces customer's surplus, the negative relationship between price and customer buying probability on the web has been pointed out (Liang and Huang 1998, Goolsbee 2001). The increase of day trading makes customers more sensitive to price, hence commissions have been declining to unprecedented lows in the competitive market of online brokerage (Balasubramanian, et al. 2003, Strader and Ramaswami 2004, Looney et al. 2006). Especially, in conditions characterized by quality uncertainty, price plays an increased role in attracting customers (Jiang and Rosenbloom 2005).

Service quality also has been postulated as a critical factor influencing the consumer satisfaction and usage intention. Shankar et. al (2003) argue that satisfaction from online service positively reinforces consumers' loyalty to the online business. Furthermore Zhang and Prybutok (2005) point out that the quality impact on satisfaction is connected to the usage intention of the online service. In the online banking area, many studies empirically support the relation between usage of the online banking system and customers satisfaction determined by the quality of the online banking system (Pikkariainen et al. 2004, Floh and Treiblmaier 2006). Hence, Zhu and Kraemer's study (2002) shows that the integrative EC capability, measured by service quality of things such as transaction, interaction and information, actually contributes to the performance of the online business.

Therefore, favorable price and quality affect online traders' choice decision of online brokerage, which leads to the determination of the brokerage's market share. Taking account of both factors in our model makes it possible for us to gauge their relative contributions to the firm's performance. We first hypothesize that there is an "instant" and "temporary" contribution of low price and high quality of online brokerage services on the market share, from a short-term perspective.

H1a. The price of online brokerage services is negatively related to their short-term market share.

H1b. The quality of online brokerage services is positively related to their short-term market share.

The claim on frictionless commerce leads to low search and negligible switching cost on the web (Gandal 2001). However, the important aspects of price and quality of online brokerage service help us to distinguish our study from alternative analyses of the other online services with low switching cost. Online brokerages have been aggressively investing in the development of more user-friendly, faster and safer trading systems as well as providing many research reports on the various investment choices. As a rationale for this phenomenon, Chen and Hitt's study (2002) argues that online brokerages can control their switching costs through the quality of their online trading systems (e.g. system's ease of use, product variety, or information provision). Hence, the competitive advantage of online service quality has been stressed even in the perspective of long-term performance (Rajgopal et al.'s study 2001). Moreover, Bowen and Hedges (1993) argue that low service quality explains more than 70 percent of the customer attrition in the financial market. However, Rajgopal et al.'s study (2001) points out that price leadership in internet business does not build sustainable advantage because it is easily imitated by competitors and instantly searchable by customers. The instant comparability of price makes non-price competitive advantages such as service quality more critical in retaining customers (Jiang and Rosenbloom 2005). Therefore, we expect the high quality online trading system to contribute to the market share for long-term time periods while the low price strategy will not.

H2. The quality of online brokerage services is positively related to their long-term market share.

Studies on price (Smith and Brynjolfsson 2001, Goolsbee 2001, Balasubramanian et al. 2003, Kim and Xu 2007) and quality (Devaraj et al. 2002, Chen and Hitt 2002, Rohm and Swaminathan 2004) show that these two factors are central determinants of consumer choices (Dumrongsiri et al. 2008). However, since both price and quality have been the subject of separate studies, we need to provide an integrated analysis of these two factors. Without the glue of quality satisfaction, online business cannot protect their customers from defection. But, if they are highly satisfied, the impact of introductory offers and entry-detering tactics will persist. Even with the same low commission strategy, some brokerages providing high quality service may increase market share while others of low quality service may not. For example, Kiwoom Securities, a low market share online brokerage in Korea, offered a very low commission - 0.025 percent of the transaction amount - which was the same market penetration strategy of another laggard, Korea Investment and Securities. While the former could become one of the top three online brokerages in terms of market share through continuously upgrading its trading system, the latter failed to provide a quality trading

system, and customers easily made the decision to switch to other brokerages. This real example suggests the probability that quality plays a moderating role on price effects. Therefore, in addition to the separate effects of price and quality, we investigate the interactive effect of these two factors combined.

H3. The higher the system quality, the more significant the effect of low price on market share gain.

In the online market, despite the frictionless commerce argument, greater price dispersion is observed than in the offline market (Brynjofsson and Smith 2000) and our dataset also exhibit price dispersion in terms of brokerage commission (see Table 2). Moreover, Pan et al.'s study (2002) argues that the price dispersion on the web is not well explained by the different service qualities but by the market characteristics such as a number of competitors. However, these studies were based on the sale of physical goods (e.g. book, CD, computer), which have little uncertainty in even non-price factors and online trading system bears higher risk (due to uncertainty in quality) than items such as books or CD's. Therefore, we hypothesize the relationship between price and quality based on the notion of switching costs. Economists (Klemperer 1987, Beggs and Klemperer 1992) explain why switching costs are closely related not only to the price wars in a competitive market but also to the ex-post supra-normal rent. High switching costs give firms some degree of monopoly power over their customers so that they optimize their prices to get customers "locked-in" after they successfully adopt the price discount strategy to increase market share. This positive relationship between switching cost and price has been empirically supported in oligopolistic settings in several industries: credit cards (Ausubel 1991), banking (Sharpe 1997), and telephone carriers (Knittel 1997). Adopting the empirical evidence in Chen and Hitt's study (2002) that each firm has a different switching cost, which is significantly determined by the quality of the trading system, we investigate the existence of a positive relationship between system quality and price (commission) in the online brokerage market.

H4. The price of online brokerage services is positively related to the service quality.

Data and Model

Data

The growth of online trading is a worldwide trend, including the most IT-developed Asia-Pacific countries. Since the deregulation of online trading in 1997, the volume of online trading has been increasing dramatically in Korea. Our data consists of a balanced panel of quarterly observations for 20 Korean online brokerages, spanning eight years from 2000 to 2007, hence the total sample size is 640. While limiting data to one country may risk the generalization of findings, there are several merits of utilizing this data set. By the end of 2006, the proportion of online trading reached about 80% of total accounts in Korea. In comparison, at the same time in Taiwan, online investing accounted for only 19% of total accounts (Lee 2008), this is a much higher rate of diffusion. Borenstein and Saloner (2001) argued that determining long-term effects of electronic commerce were especially difficult because markets were far from equilibrium. They noticed the "land rush" to gain first-mover market position and other advantages with very aggressive strategies such as unsustainable steep price discounts. We suspect that earlier empirical ecommerce studies in IS may not be perfectly immune to this problem. In the case of our study, the extremely high penetration of online trading in Korea shows that online brokerage services have reached a mature stage. The national statistics show that an absolute majority of individual traders has adopted online brokerage services, so the market is not skewed by minority of netizens. In addition, longer periods of panel data provide the opportunity to investigate long-term effects, as alluded earlier.

We have three data sources for three major variables: market share of online brokerage, commission charged for the service, and quality of service. The market share data is from the DART (Data Analysis, Retrieval and Transfer System) database (<http://dart.fss.or.kr>). DART is an electronic system that allows companies to submit disclosures online. From this public site, we retrieved the financial statements of security firms and found online brokerage-related revenues on a quarterly basis. The online brokerage commission data is from the KSDA (Korea Securities Dealers Association) website (<http://www.ksda.or.kr>), which publishes up-to-date stock market data (e.g. brokerage commissions) and current economic and financial news on the firms listed in the stock market. We obtained system quality data from Stockpia.com, a leading rating agency for the finance sector. Similar to the Forrester.com or Gomez Advisors, Stickpia.com provides the expert ratings of online brokerage services. It has appraised the quality of online brokerage systems in various dimensions, and released rankings and scores on a quarterly basis since 2000. The appraisers are composed of academicians in related areas and internal firm experts.

Construction of Variables and Model

The dependent variable in our model is the market share of online brokerages. For the measure of this variable, we employ the relative proportion (percentage) of each brokerage's revenue to the total revenue of the market. Generally, online brokerages have two main revenue sources: gains from trading in their own securities or derivatives accounts and brokerage service revenue. We limit our study to the latter to derive market share for online brokerages. Additionally, online brokerage revenue can be decomposed into two parts: online brokerage commissions and interest revenue. Hence, we derive market share not only in terms of total brokerage revenue but also in terms of brokerage commissions or interest revenues and investigate the determinants of both full and component market share. In this way, we can examine the relative importance of variables on the different revenue sources.

Online brokerages implement different price schemes. Some charge a per-transaction commission on a flat fee basis and others charge as a proportion of the transaction amount. Hence, KSDA adopts four thresholds relative to per-transaction amounts to compare each brokerage's commission: \$5,000, \$20,000, \$50,000, and \$200,000. Following this classification, we adopt the commission charged for a transaction of \$5,000 which is presumably the most frequent transaction amount.

Although the quality issue has received significant attention in prior studies (Gronroos 1984, Dabholkar 1996), due to its implicitness and intangibility, the construction of this variable is not easily observed, especially in IT-based service studies (e.g., financial area, Krishnan et al. 1999). Various dimensions of quality – product variety (Rohm and Swaminathan 2004), information availability (Hoffman and Novak 1996), convenience (Davis et al. 1989), and interactivity (Alba et al. 1997) – should be carefully considered as the relevant way for the situation where they are measured (Gronroos 1984). Hence, we need to explain how the quality variable in this study is constructed and measured by the data source company. Stockpia.com adopts five sub constructs for quality measurement of online brokerage systems: 1) trading functionality, which considers general trading convenience as well as the variety of functions and menus for online stock, option, and futures trading, 2) information provision, which measures the quality of information on the market such as charts, investment guides, and various research reports, 3) communication channel, which evaluates the quality of communities or education tools for advising customers investment decisions (e.g. financial product selection, stock investment), 4) customer support, which examines the quality of help menus, personalization services and, privacy protection, 5) finally, system speed and stability. System speed is measured by examining the screen loading time for information menus and real transaction time for trading menus, while system stability is measured by the frequency of response delay or failure. Each criterion has sub items for construction (a total of about 400 items for 5 criteria) and the reliability and consistency for construction are verified by Stockpia.com. For the evaluation of total service quality, different weights according to the AHP (Analytical Hierarchy Process) analysis are arranged to five criteria: trading functionality (0.34), information provision (0.31), communication channel (0.12), customer support (0.17), speed and stability (0.06). By summing the weighted scores for the five criteria, total scores are assigned, which are adopted as quality measurements for online brokerage systems. As an additional firm-specific characteristic, we consider the size of online brokerages in terms of the number of staff and branch offices. The definitions of key variables are as follows.

Table 1. Definitions of Variables

	Variable	Definitions
DV	MS_REV _{i,t}	market share of online brokerage in terms of total revenue for brokerage i at time t
	MS_COM _{i,t}	market share of online brokerage in terms of brokerage commission for brokerage i at time t
	MS_INT _{i,t}	market share of online brokerage in terms of interest revenue for brokerage i at time t
IV	PRICE _{i,t}	brokerage commission charged per \$5,000 transaction for brokerage i at time t
	QUALITY _{i,t}	the quality of online trading system for brokerage i at time t
	STAFF _{i,t}	number of staff for brokerage i at time t
	BRANCH _{i,t}	number of branches for brokerage i at time t

Because our dependent variable is market share, it is bounded in a range of values (0~100 %). Therefore, we need to take the logit transformation of this variable so that, by following the conventional market share model which adopts MNL transformation of model (see the theoretical background section), we handle this problem in developing our models for empirical testing (Duan et al. 2008). For testing H1 ~ H3, with an analogy to equation (9), we develop the following dynamic model with lagged variables and refer to it as model I:

$$\begin{aligned} \log(\text{MS})_{i,t} = & \alpha_i + \beta_1(\text{PRICE})_{i,t} + \beta_2(\text{PRICE})_{i,t-1} + \beta_3(\text{PRICE})_{i,t-2} \\ & + \beta_4(\text{QUALITY})_{i,t} + \beta_5(\text{QUALITY})_{i,t-1} + \beta_6(\text{QUALITY})_{i,t-2} \\ & + \beta_7(\text{PRICE})_{i,t} * (\text{QUALITY})_{i,t} + \beta_8(\text{PRICE})_{i,t-1} * (\text{QUALITY})_{i,t-1} + \beta_9(\text{PRICE})_{i,t-2} * (\text{QUALITY})_{i,t-2} \\ & + \beta_{10}(\text{BRANCH})_{i,t} + \beta_{11}(\text{STAFF})_{i,t} + \varepsilon_{i,t} + \delta_t \end{aligned}$$

We denote MS as one of three dependent variables of market share in Table 1 and the interaction terms capture the effect of price on market share moderated by quality. Here, (Variable)_{i,t} captures the instant impact of the variable on the market share of the current period, hence this is for capturing the short-term effect. In order to capture the persistent influence of brokerage commissions or quality on market share, we introduce two more lagged variables – (Variable)_{i,t-1} and (Variable)_{i,t-2}. Therefore, the lagged variables capture the long-term effects. In Rajgopal et al.'s study (2001), long-term impact of variables (e.g. customer experience, cost) on the online firms' performance is investigated even with the variables in the same periods. They examined the financial performance of online firms (price-to-sales ratio) and argued that the outcome of the current financial performance already reflects the long-term competitive advantages of the variable. Our study also investigates the financial performance of online brokerages. However, for the deeper analysis on the sustainable impact of some factors, we adopt not only the current-time variables but also lagged-variables. For the online brokerage business where the price and quality change very frequently, Stockpia.com announces its evaluation on a quarterly basis. Moreover, the financial performance of the firm is also reported on a quarterly basis. If we consider the speedy environmental changes of online brokerage business, the two periods' time lag carries significant meaning in the long-term perspective. Finally to test H4, we developed the following model II:

$$\log(\text{PRICE})_{i,t} = \alpha_i + \beta_1(\text{QUALITY})_{i,t} + \beta_2(\text{QUALITY})_{i,t-1} + \beta_3(\text{QUALITY})_{i,t-2} + \varepsilon_{i,t} + \delta_t$$

The use of panel data provides a means of resolving or reducing a critical econometric problem of the omitted variables correlated with an explanatory variable (Hsiao 1986). By utilizing information on both the inter-temporal dynamics and the firm's individuality, we can better control the effects of unobserved variables.

Results and Discussion

Tables 2 and 3 show the descriptive statistics and correlations of variables.

Table 2. Descriptive Statistics							
	MS_REV	MS_COM	MS_INT	PRICE	QUALITY	BRANCH	STAFF
Mean	3.3143	3.4496	3.1610	5.6614	74.6202	45.9335	954.6092
Max.	13.34	14.13	17.71	10	95	145	3388
Min.	0.03	0.03	0.02	1	14	1	19
Sum	2094.67	2180.15	1997.76	3578	47160	29030	603313
Std. Dev.	3.2319	3.4846	3.3749	2.6206	12.9711	34.6184	738.5512
Total Obs	640	640	640	640	640	640	640
# of firms	20	20	20	20	20	20	20

Table 3. Correlations

	MS_REV	MS_COM	MS_INT	PRICE	QUALITY	STAFF	BRANCH
MS_REV	1.000000						
MS_COM	0.963802	1.000000					
MS_INT	0.900092	0.765875	1.000000				
PRICE	0.570603	0.546040	0.527931	1.000000			
QUALITY	0.583197	0.598742	0.448757	0.160786	1.000000		
STAFF	0.944963	0.933263	0.824880	0.638053	0.586362	1.000000	
BRANCH	0.895956	0.894729	0.758933	0.601177	0.575995	0.962092	1.000000

Our data emphasizes one aspect of the competitiveness in the online brokerage business. The maximum market share of one online brokerage is 13.34 percent over an eight year period, with a mean of 3.31 percent. Hence, we do not observe a dominant market concentration by any of the online brokerage firms. Quality and price discrimination are also observed in the data. Through the descriptive statistics in Table 2, we can find a significant variance between minimum and maximum values of these variables.

Finally, we checked for multicollinearity due to the relatively high correlations between some independent variables (STAFF and BRAND, PRICE and STAFF, PRICE and BRAND). Hair et al.'s study (1995) recommends 10.0 as the cut-off score for acceptable VIF (Variance Inflation Factors) while 1.00 indicates little or no multicollinearity. The resultant VIFs for all of our independent variables were acceptable: 1.002 (for PRICE) ~ 1.026 (for BRAND) when MS_REV is a dependent variable, 1.017 (for PRICE) ~ 1.021 (for QUALITY) when MS_COM is a dependent variable, 1.005 (for PRICE) ~ 1.039 (for QUALITY) when MS_INT is a dependent variable.

Because a fixed-effect model does not make any specific assumptions on the distribution of the error terms, it can be used for a wider range of problems (Judge et al. 1982). We investigate the application of GLS (Generalized Least Squares), which is usually adopted for the analysis of time series data with the possibility of heteroscedasticity in the error terms. The results of the test are summarized in Table 4. We include the times-series and cross-sectional fixed effects in all of the models but omit them here. The testing results of model I and II are as follows:

Table 4. Results of Testing Model I and II : GLS (Fixed Effect Model)

	model (a)	model (b)	model (c)	model (d)
IV \ DV	MS_REV _{i,t}	MS_COM _{i,t}	MS_INT _{i,t}	PRICE _{i,t}
PRICE _{i,t}	0.1535* (0.0219)	0.1071 (0.0862)	0.2974** (0.0024)	
PRICE _{i,t-1}	0.0903 (0.1450)	0.0712 (0.1984)	0.1551 (0.0915)	
PRICE _{i,t-2}	0.0002 (0.9975)	0.0132 (0.7948)	0.0662 (0.4271)	
QUALITY _{i,t}	0.0148 ** (0.0023)	0.0098* (0.0298)	0.0159* (0.0163)	0.0094** (0.0036)
QUALITY _{i,t-1}	0.0092* (0.0290)	0.0048 (0.2056)	0.0169** (0.0033)	0.0047 (0.0029)
QUALITY _{i,t-2}	0.0076 * (0.0449)	0.0030 (0.3814)	0.0179** (0.0013)	0.0008 (0.0025)
BRANCH _{i,t}	0.0084** (0.0000)	0.0026* (0.0130)	0.0052* (0.0196)	
STAFF _{i,t}	0.0001 (0.1020)	0.0006** (0.0000)	0.0002 (0.1374)	
PRICE _{i,t} *QUALITY _{i,t}	-0.0025** (0.0037)	-0.0014 (0.0734)	-0.0041** (0.0005)	
PRICE _{i,t-1} *QUALITY _{i,t-1}	-0.0011 (0.1446)	-0.0007 (0.3022)	-0.0018 (0.0769)	

PRICE _{it-2} * QUALITY _{it-2}	-0.0003 (0.6604)	-0.0006 (0.3322)	-0.001 (0.302)	
# of Obs.	600	600	600	600
Adj-R ²	0.96	0.97	0.91	0.99

- * p<0.05, ** p<0.01, the number in parenthesis is p-value.

- IV(Independent Variable) DV(Dependent Variable)

Total sample size is 640, but the size of sample adopted by panel regression is 600 (from the third quarter of 2000 to the fourth quarter of 2007 for 20 brokerages) because of two periods' time lag in our model. The results illuminate the great importance of system quality in the establishment of an online brokerage's market share. First, model (a) shows the effects of factors on the total market share. We observe that the quality factor has a significantly positive effect on long-term and short-term market share. It is worth noting that the cost of customer retention based on quality management is significantly lower than the cost of new customer acquisition (Krishnan et al. 1999), although neither of them is negligible (Devaraj et al. 2002). Our results explain how important the establishment of a high quality systems is in terms of long-term returns for online brokerages. By attracting and locking in customers, the salient contribution of system quality is observed over the lagged periods. On the other hand, we discover no significant contribution of a price strategy to the long-term market share. However, we observe the positive relationship between price and short-term market share, which implies that the price discount can lead to the reduction of short-term revenue. Although online brokerages have greatly depended on the price discount strategy to acquire new customers, this strategy does not show a positive impact on the market share increase. However, the moderated effect of price by quality is significant. It shows that the establishment of a high quality trading system is a fundamental condition for a successful commission discount strategy: this combination successfully increases revenue, sufficiently compensating the decrease in price through the increase in the customer-base.

By decomposing our dependent variable, **MS_REV**, into the **MS_COM** and **MS_INT**, we take a deeper look at the impacts of price and quality. Table 4 shows that the result of total market share (model (a)) is mainly led by model (c). Consistent with model (a), in model (c), the quality and price have a positive impact on the increase of interest revenue. While quality impact persists over long-term periods, price impact is limited to a short-term period. Moreover, the moderated negative impact of price by quality is also observed in model (c). From the following table, we can find some clues on why the results of model (c) are closely connected to the results from model (c).

Table 5. Revenue Sources of Online Brokerage					
2007 (semiannually)		K. Brokerage (Pure Online)		D. Brokerage (Click & Mortar)	
Revenue Sources		\$M	Ratio(%)	\$M	Ratio(%)
Brokerage	Commission	83.12	29.12%	255.17	17.95%
	Interest	58.26	20.41%	81.67	5.75%
Asset Management	Gain on sales of trading / valuation securities	37.05	12.98%	348.24	24.50%
	Gain on derivative Transactions	105.25	36.87%	707.76	49.79%
Etc.		1.81	0.63%	28.55	2.01%
Total		285.49	100.00%	1421.38	100.00%

Table 5 presents the revenue of two online brokerages for the half-year of 2007. First, it shows that brokerage revenue reached 49.53 percent and 23.7 percent of total revenues for a purely online brokerage and for a click and mortar brokerage firm, respectively. An interesting point is that the interest revenue from brokerage services

represents a significant portion of total online brokerage revenue, especially in the case of a purely online brokerage which offers limited brokerage services compared to conventional firms. The portion of interest revenue results is almost half of its brokerage revenue. This implies that the business performance of online brokerages highly depends on the factors that increase interest revenue of online brokerage. While the commission of brokerage services is falling, the discounted commission attracts more customers to the brokerage firm. Increased customer-base leads to higher returns by generating more revenue from interests of margins or interests of money loans. For online brokerages, commission revenue has been an explicit and primary source of revenue while interest revenue has been an implicit and secondary source of revenue. However, our results show that the latter is playing a more significant role in establishing market share for online brokerages. Table 4 shows that the commission is manipulated in order to increase interest revenue, thereby increasing total revenue, instead of increasing commission revenue. The negatively significant effect of interaction term in model (c) (in Table 4) has very important meaning. First, it means that, when a price discount strategy is adopted by an online brokerage, if its service quality is sufficiently attractive, it can increase its revenue. It is because the increased user-base by discounted commission delivers more interest revenues, although its marginal revenue from commission is discounted. Therefore, in order to achieve real business value and durable business model, online brokerages need to understand how to combine the price and quality factors to attain an overall increase in revenue.

The testing results of H4 are in the model (d) (see Table 4). Based on Chen and Hitt's argument (2002) that each firm has a different switching cost determined by the quality of its trading system, we adopted quality as a proxy variable for switching cost. Moreover, by providing evidence of a significant impact of quality on the long-term market share of online brokerages, we demonstrate the appropriateness of our assumption about quality and switching cost. Now, our results in Table 7 show that, even if the market for online brokerages is strongly competitive, a positive relationship exists between price and quality. Our results are in line with previous studies (Ausubel 1991, Knittel 1997, Sharpe 1997) showing the positive relationship between price and switching cost. Hence, the test results of H3 and H4 jointly derive the following conclusion. The brokerages offering high quality systems usually charge higher commissions for their services. Further, only these high quality brokerages can expect a significant effect from a commission discount strategy even though most brokerages expect to see a market share increase result from a commission discount. This highlights the value of both low entry and high lock-in for the acquisition and retention of customers. The unsuccessful cases of low quality brokerages offering extremely low prices coincide with our results. As one of the deep-discount brokerages in the U.S., E-trade made aggressive introductory offers to acquire customers, however the extremely low switching cost led E-trade to be unsuccessful in establishing market share (Chen and Hitt 2002).

Additionally, we identify BRANCH as having a significantly positive impact on market share. Even in the online brokerage business, we can find the important impact of a firm's physical size. First, the signaling effect of the firm size deserves attention (Hellofs and Jacobson 1999). Due to the mission criticalness of online brokerage services, having trust in an online brokerage in terms of business capability and resources appears to be important to consumers. Although the physical branch is not the main channel for transactions, the number of branches still plays an important role in increasing customer satisfaction in online brokerages (Balasubramanian et al. 2003). Second, the benefit of complementary services from the integration of online and offline channels can be another reason supporting this result (Krishnan et al. 1999). The integration of multi-channel facilities gives consumers wider and better access to their investments (Klein et al. 2000). Hence, although the financial sector has been consolidating, the number of branches has been continuously increasing (Morrall 1996). The reason for this is reflected in our results.

Conclusion

In May of 2008, the lowest online brokerage commission in Korea was 0.015 percent of transaction value, however the commission discount war is still ongoing, threatening the profitability of the online brokerage industry (KSDA 2008). Our study provides a cautionary notice about online brokerages' blind myth of low commission effects. We identify trading system quality as a dominant determinant of online brokerage market share. We argue that the success of commission discount strategy is sustainable only with the provision of high quality systems for online traders, not the simple discounting of commissions.

Moreover, our results highlight the growing importance of interest revenue in the online brokerage business. Of course, brokerage commissions are a source of primary and direct revenue from brokerage services. However, the importance of interest is increasing, and its contribution to total brokerage revenue is absolutely not negligible and the pricing models which assumed that the transaction commissions would be the source of revenues are losing their

relevance as the cost of transactions declines (Klein et al. 2000). If this issue is considered, the strategy of an online brokerage firm should be more carefully designed to target customers with a high profit contribution in a wide collection of brokerage services. For example, brokerages may need to consider the asset (deposit) based charging rather than the transaction based charging in order to incentivize customers to concentrate their assets in a single place.

Our study has significant value in that we give explicit answers to the controversial but untested arguments about online brokerage success. In 2007, the average IT spending of Korean brokerages reached about 13 percent of their total budgets. About \$600M was spent by the company with the highest IT investment that year (IT Today 2007). Our results could provide a partial justification for such an aggressive investment to improve system quality. However, although the contribution of quality investment to the market share is validated in our study, its contribution to the profitability is not explained yet. If we consider the IT spending for improving service quality, profitability of quality investment can be another study with that of our market share and revenue study. For understanding the real value of quality investment, we need to consider the cost of quality investment. This is a significant issue for further study.

The managerial implications of our study are not just limited to online brokerages but can be extended to other ecommerce firms that are weighing strategies to balance price and quality. Moreover, we argue the importance of identifying the impact of these two factors on the implicit revenue sources as well as explicit ones. Further investigation on market dynamics (e.g. entry, exit, and merge) will be an extension of this study, and will better explain the performance of the online brokerage business. Comprehensive examination of both market and firm characteristics will enrich our understanding of the attributes of online businesses.

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